PERCEPTRON NEURAL NETWORK. POTENTIAL WAY OF USE

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Neural network is a mathematical model, its software and technical realization. I have decided to take 2 perceptron types - single and multi. I decided to find out why multi-layer perseptron is used in calculations of nuclear reactions. Let's start with a structure of the single-layer network.

As you can see on the screen the network has only one layer - output, because the input layer does not make any counts. On the input and output layer such network takes and gives binary function. For a certain number of steps the network learns to give correct answers. Typically, the speed of learning decreases with increasing data. Often for speed function of learning it is chosen the $\varepsilon(t) = 1 / at$, $a > 0$ or a similar functions. Power of network is not big, because the neurons have a threshold function with the only answer 0 or 1.

Now let's look at the multilayer perceptron. The network can have many layers. All layers are hidden, except the output layer. Each neuron has a non-linear activation function. Non-linear function is very important, because otherwise the network can be changed to a single layer perceptron. The more layers, the more difficult to learn the system and the moretime it takes. At the same time training can be unsuccessful.

I made a table to make it easier to compare the characteristics of networks, you can see it on the screen.

If you want to understand clearly difference between networks there is an example of single-layer perseptron work. It is recognition of alphabet letters and geometrical figures. That is all, the highest level of such network.

Example of potential use of a multilayered perseptron is measuring channels on the NPP

As you know all parameters from reactor, turbine and all systems go to operator room by measuring channels. But channels have their own time of life. With the help of a neuronet staff can understand when the channel begins to give a deviation of parameter. Parameters from a neuronet arrive in operator room parallel with parameters from channels. There is an available deviation for each parameter. If parameter by channel has a deviation from neural network and this deviation is bigger then available it means that channel crashes and we have to repair it.

REFERENCES:

1. http://www.library.mephi.ru/data/scientific-sessions/1999/Neuro_3/(28.05.16)
2. http://www.aiportal.ru/articles/neural-networks/multi-perceptron.html(28.05.16)

3. http://www.aiportal.ru/articles/neural-networks/classification.html(28.05.16)
4. http://cgm.computergraphics.ru/content/view/57#classic_rozenblat(28.05.16)
5. http://www.gidropress.podolsk.ru/files/proceedings/mntk2015/documents/mntk2015-039.pdf(28.05.16)
6. http://www.spazint.ru/energetika/atomnaya-energiya/nejronnye-seti.html(28.05.16)

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RANDOM PERTURBATIONS IN THE PROPERTIES OF THE REACTOR ENVIRONMENT NOISE GENERATOR MATHEMATICAL MODEL

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Everyone knows that all reactor characteristics have uneven distribution over the reactor core. At the present time, very few calculations are carried out to take into account this unevenness, however, it is impossible to obtain absolute results, because this “Unevenness” is impermanent in time due to multiple factors. Empirical formulas obtained empirically are often used for simplification. As well as the created mathematical models which qualitatively describe the unevenness. Here we will demonstrate this by the example of noise generator

There was reviewed a one-dimensional reactor model, which greatly simplifies the modeling of statistical experiment. We consider a one-dimensional reactor as a flat plate.

In our research we have applied mathematical model named "high-altitude model", in relation to the RBMK reactor.

For the simulation of random variables we have used noise generator method, which is described mathematically as follows:

$$a_2 \frac{d^2x(t)}{dt^2} + a_1 \frac{dx(t)}{dt} + a_0 x(t) = b_1 \frac{d\xi(t)}{dt} + b_0 \xi(t) \quad (1)$$

All these factors are taken from the RBMK archives.

The following results were obtained on the basis of a mathematical model of the particles flow and the noise generator: The increase of the reactor’s size and the noise level leads to the expected value deviates from fundamental solution and the variance is characterized by the appearance of the peaks and moving them to the edges of the reactor.

Further, according to the archives there was built graphics 4 sections RBMK. In general, all the sensors show the same trend: the lower Expected value and the